

We Claim:

1. A peptide having an amino acid sequence selected from the group consisting of MYRPPAANVDPW (SEQ ID NO:76), SSPPDLTTRTP (SEQ ID NO:77), ATTQSTPPAFHL (SEQ ID NO:78), SDLPHVSSYWRG (SEQ ID NO:79), TTTQFMEIRQSA (SEQ ID NO:80), GKTWKASDEDWT (SEQ ID NO:81), DPARILGRIFL (SEQ ID NO:82), YNLQPTTSARPT (SEQ ID NO:83), SLKTPTTSHLSQ (SEQ ID NO:84), TFDLRNNTHRNP (SEQ ID NO:85), SVSVGMKPSRP (SEQ ID NO:86), RRQRR (SEQ ID NO:97), RRQRRQRR (SEQ ID NO:98), RRQRRQRRQRR (SEQ ID NO:99).

2. The peptide of claim 1 wherein said peptide facilitates cellular internalization of a cargo linked thereto.

3. The peptide of claim 2 wherein the peptide has the amino acid sequence TLPSPLALLTVH (SEQ ID NO:59).

4. The peptide of claim 2 wherein the peptide has the amino acid sequence SVSVGMKPSRP (SEQ ID NO:86).

5. The peptide of claim 1 wherein the peptide provides for nuclear translocation in a target cell.

6. A peptide-cargo complex comprising a peptide and a cargo wherein the peptide has an amino acid sequence selected from the group consisting of MYRPPAANVDPW (SEQ ID NO:76), SSPPDLTTRTP (SEQ ID NO:77), ATTQSTPPAFHL (SEQ ID NO:78), SDLPHVSSYWRG (SEQ ID NO:79), TTTQFMEIRQSA (SEQ ID NO:80),

GKTKWKASDEDWT (SEQ ID NO:81), DPARILGRIFL (SEQ ID NO:82), YNLQPTTSARPT (SEQ ID NO:83), SLKTPTTSHLSQ (SEQ ID NO:84), TFDLRNNTHRNP (SEQ ID NO:85), SVSVGMKPSRP (SEQ ID NO:86), RRQRR (SEQ ID NO:97), RRQRRQRR (SEQ ID NO:98), RRQRRQRRQRR (SEQ ID NO:99).

7. The peptide-cargo complex of claim 6 wherein the cargo is selected from the group consisting of a polynucleotide, a polypeptide, a small molecule, a virus, a modified virus, a viral vector, and a plasmid.

8. The peptide-cargo complex of claim 6 wherein the cargo is a virus selected from the group consisting of adenovirus, adeno-associated virus, herpes simplex virus, and retrovirus.

9. The peptide-cargo complex of claim 6 wherein the cargo is selected from the group consisting of therapeutic proteins, suicide proteins, tumor suppressor proteins, transcription factors, kinase inhibitors, kinases, cell cycle regulatory proteins, apoptotic proteins, anti-apoptotic proteins, viral antigens, cellular antigens, differentiation factors, immortalization factors, toxins, antibodies and inhibitors of NF- $\kappa$ B.

10. The peptide-cargo complex of claim 6 wherein the peptide facilitates cellular internalization of cargo linked thereto.

11. The peptide-cargo complex of claim 6 wherein the peptide provides for nuclear translocation of said peptide-cargo complex in a target cell.

12. The peptide-cargo complex of claim 6 wherein the peptide is biotinylated and the cargo is avidin labeled.

13. The peptide-cargo complex of claim 9, wherein the cargo is an apoptotic protein selected from the group consisting of p53, caspase-3, HSV thymidine kinase and an antimicrobial peptide.

14. The peptide-cargo complex of claim 6 wherein the cargo is glutathione.

15. The peptide-cargo complex of claim 6 wherein the peptide has the amino acid sequence TLPSPALLTVH (SEQ ID NO:59).

16. The peptide-cargo complex of claim 6 wherein the peptide has the amino acid sequence SVSVGMKPSRP (SEQ ID NO:86).

17. The peptide-cargo complex of claim 6 wherein the peptide is biotinylated and the cargo is avidin-labeled.

18. An expression cassette comprising a DNA encoding a fusion protein comprising a leader sequence, a protein of interest and an internalizing peptide having an amino acid sequence selected from the group consisting of MYRPPAANVDPW (SEQ ID NO:76), SSPPPDLTTRTP (SEQ ID NO:77), ATTQSTPPAFHL (SEQ ID NO:78), SDLPHVSSYWRG (SEQ ID NO:79), TTTQFMEIRQSA (SEQ ID NO:80), GKTWKASDEDWT (SEQ ID NO:81), DPARILGRIFL (SEQ ID NO:82), YNLQPTTSARPT (SEQ ID NO:83), SLKTPTTSHLSQ (SEQ ID NO:84), TFDLRNNTHRNP (SEQ ID NO:85),

SVSVGMKPSRP (SEQ ID NO:86), RRQRR (SEQ ID NO:97), RRQRRQRR (SEQ ID NO:98), RRQRRQRRQRR (SEQ ID NO:99).

19. The expression cassette of claim 18 further comprising expression control sequences operatively linked to said DNA.

20. A transfer vector comprising the expression cassette of claim 19.

21. The expression cassette of claim 18, wherein said leader sequences are selected from the group consisting of Il-1ra, PTH, VP-22 and related sequences.

22. The expression cassette of claim 18 wherein the protein of interest is selected from the group consisting of apoptotic proteins, anti-apoptotic proteins, cell cycle regulatory proteins, transcription factors, suicide gene products, viral or tumor antigens, and cell proliferation factors.

23. The expression cassette of claim 18, wherein the encoded fusion protein comprises an amino acid sequence which facilitates removal of leader sequences therefrom and wherein said leaderless fusion protein comprises an internalizing peptide and a protein of interest.

24. The expression cassette of claim 18 wherein said fusion protein encoded thereby is produced and secreted from a cell and subsequently internalized into surrounding cells.

25. A method for inducing synovial cell death comprising administering a peptide-cargo complex to said synovial cell, wherein the peptide has an amino acid sequence

selected from the group consisting of MYRPPAANVDPW (SEQ ID NO:76), SSPPDLTTRTP (SEQ ID NO:77), ATTQSTPPAFHL (SEQ ID NO:78), SDLPHVSSYWRG (SEQ ID NO:79), TTTQFMEIRQSA (SEQ ID NO:80), GKTWKASDEDWT (SEQ ID NO:81), DPARILGRIFL (SEQ ID NO:82), YNLQPTTSARPT (SEQ ID NO:83), SLKTPTTSHLSQ (SEQ ID NO:84), TFDLRNNTHRNP (SEQ ID NO:85), SVSVGMKPSRP (SEQ ID NO:86), RRQRR (SEQ ID NO:97), RRQRRQRR (SEQ ID NO:98), RRQRRQRRQRR (SEQ ID NO:99).

26. A method for inducing apoptosis in a tumor cell comprising administering a peptide-cargo complex to said tumor cell, wherein the peptide has the amino acid sequence selected from the group consisting of MYRPPAANVDPW (SEQ ID NO:76), SSPPDLTTRTP (SEQ ID NO:77), ATTQSTPPAFHL (SEQ ID NO:78), SDLPHVSSYWRG (SEQ ID NO:79), TTTQFMEIRQSA (SEQ ID NO:80), GKTWKASDEDWT (SEQ ID NO:81), DPARILGRIFL (SEQ ID NO:82), YNLQPTTSARPT (SEQ ID NO:83), SLKTPTTSHLSQ (SEQ ID NO:84), TFDLRNNTHRNP (SEQ ID NO:85), SVSVGMKPSRP (SEQ ID NO:86), RRQRR (SEQ ID NO:97), RRQRRQRR (SEQ ID NO:98), RRQRRQRRQRR (SEQ ID NO:99).

27. A method for reducing white blood cells in arthritic joints comprising administering a peptide-cargo complex to said white blood cells, wherein the peptide has an amino acid sequence selected from the group consisting of MYRPPAANVDPW (SEQ ID NO:76), SSPPDLTTRTP (SEQ ID NO:77), ATTQSTPPAFHL (SEQ ID NO:78), SDLPHVSSYWRG (SEQ ID NO:79), TTTQFMEIRQSA (SEQ ID NO:80), GKTWKASDEDWT (SEQ ID NO:81), DPARILGRIFL (SEQ ID NO:82), YNLQPTTSARPT (SEQ ID NO:83), SLKTPTTSHLSQ (SEQ ID NO:84), TFDLRNNTHRNP (SEQ ID NO:85),

SVSVGMKPSRP (SEQ ID NO:86), RRQRR (SEQ ID NO:97), RRQRRQRR (SEQ ID NO:98), RRQRRQRRQRR (SEQ ID NO:99).

28. A method for inhibiting apoptosis in an islet cell comprising administering a peptide-cargo complex to said islet cell, wherein the peptide has an amino acid sequence selected from the group consisting of KRIIQRILSRNS (SEQ ID NO:1), KRIHPRLTRSIR (SEQ ID NO:2), PPRLRKRRQLNM (SEQ ID NO:3), PIRRRKCLRRLK (SEQ ID NO:4), RRQRRTSKLMKR (SEQ ID NO:5), MHKRPTTPSRKM (SEQ ID NO:6), RQSRRRPLNIR (SEQ ID NO:7), RIRMIQNLIKKT (SEQ ID NO:8), SRRKRQRSNMRI (SEQ ID NO:9), QRIRKSKISRTL (SEQ ID NO:10), PSKRLLHNNLRR (SEQ ID NO:11), HRHIRRQSLIML (SEQ ID NO:12), PQNRLQIRRHRSK (SEQ ID NO:13), PPHNRIQRRLNM (SEQ ID NO:14), SMLKRNHSTSNR (SEQ ID NO:15), GSRHPSLIIPRQ (SEQ ID NO:16), SPMQKTMNLPPM (SEQ ID NO:17), NKRILIRIMTRP (SEQ ID NO:18), HGWZIHGLLHRA (SEQ ID NO:25), AVPAKKRZKSV (SEQ ID NO:26), PNTRVRPDVSF (SEQ ID NO:27), LTRNYEAWVPTP (SEQ ID NO:28), SAETVESCLAKSH (SEQ ID NO:29), YSHIATLPFTPT (SEQ ID NO:30), SYIQRTPSTTLP (SEQ ID NO:31), AVPAENALNNPF (SEQ ID NO:32), SFHQFARATLAS (SEQ ID NO:33), QSPTDFTFPNPL (SEQ ID NO:34), HFAAWGGWSLVH (SEQ ID NO:35), HIQLSPFSQSWR (SEQ ID NO:36), LTMPSDLQPVLW (SEQ ID NO:37), FQPYDHPAEVSY (SEQ ID NO:38), FDPFFWKYSPRD (SEQ ID NO:39), FAPWDTASFMLG (SEQ ID NO:40), FTYKNFFWLPEL (SEQ ID NO:41), SATGAPWKMWVR (SEQ ID NO:42), SLGWMLPFSPPF (SEQ ID NO:43), SHAFTWPTYLQL (SEQ ID NO:44), SHNWLPLWPLRP (SEQ ID NO:45), SWLPYPWHVPSS (SEQ ID NO:46), SWWTPWHVHSES (SEQ ID NO:47), SWAQHLSLPPVL (SEQ ID NO:48), SSSIFPPWLSFF (SEQ ID NO:49),

LNVPPSWFLSQR(SEQ ID NO:50), LDITPFLSLTLP (SEQ ID NO:51), LPHPVLHMGPLR  
 (SEQ ID NO:52), VSKQPYYMWNGN (SEQ ID NO:53), NYTTYKSHFQDR (SEQ ID  
 NO:54), AIPNNQLGFPPK (SEQ ID NO:55), NIENSTLATPLS (SEQ ID NO:56),  
 YPYDANHTRSPT (SEQ ID NO:57), DPATNPGPHFPR (SEQ ID NO:58), TLPSPLALLTVH  
 (SEQ ID NO:59), HPGSPFPPEHRP (SEQ ID NO:60), TSHTDAPPARSP (SEQ ID NO:61),  
 MTPSSLSTLPWP (SEQ ID NO:62), VLGQSGYLMPMR (SEQ ID NO:63), QPIITSPYLPS  
 (SEQ ID NO:64), TPKTMTQTYDFS (SEQ ID NO:65), NSGTMQSASRAT (SEQ ID NO:66),  
 QAASRVENYMHR (SEQ ID NO:67), HQHKPPPLTNNW (SEQ ID NO:68),  
 SNPWDSLLSVST (SED ID NO:69), KTIEAHPPYYAS (SEQ ID NO:70),  
 EPDNWSLDFPRR(SEQ ID NO:71), HQHKPPPLTNNW (SEQ ID NO:72),  
 GVVGKLGQRRTKKQRRQKK (SEQ ID NO:73),  
 GRRTKKQRRQKKPPRYMILGLLALAAVCSAA (SEQ ID NO:74), GRRTKKQRRQKKPP  
 (SEQ ID NO:75), MYRPPAANVDPW (SEQ ID NO:76), SSPPDLTTRTP (SEQ ID NO:77),  
 ATTQSTPPAFHL (SEQ ID NO:78), SDLPHVSSYWRG(SEQ ID NO:79), TTTQFMEIRQSA  
 (SEQ ID NO:80), GKTWKASDEDWT (SEQ ID NO:81), DPARILGRIFL (SEQ ID NO:82),  
 YNLQPTTSARPT (SEQ ID NO:83), SLKTPTTSHLSQ (SEQ ID NO:84), TFDLRNNTHRNP  
 (SEQ ID NO:85), SVSVGMKPSRP (SEQ ID NO:86), RRQRR (SEQ ID NO:97),  
 RRQRRQRR (SEQ ID NO:98), RRQRRQRRQRR (SEQ ID NO:99).

29. The method of claim 26, wherein the tumor cell is a prostate tumor cell.

30. A method for delivering anti-oxidant and anti-inflammatory agents to lung  
 epithelial cells comprising administering a peptide-cargo complex to said lung epithelial cells,  
 wherein the peptide has an amino acid sequence selected from the group consisting of

MYRPPAANVDPW (SEQ ID NO:76), SSPPDLTTRTP (SEQ ID NO:77), ATTQSTPPAFHL (SEQ ID NO:78), SDLPHVSSYWRG (SEQ ID NO:79), TTTQFMEIRQSA (SEQ ID NO:80), GKTWKASDEDWT (SEQ ID NO:81), DPARILGRIFL (SEQ ID NO:82), YNLQPTTSARPT (SEQ ID NO:83), SLKTPTTSHLSQ (SEQ ID NO:84), TFDLRNNTHRNP (SEQ ID NO:85), SVSVGMKPSRP (SEQ ID NO:86), RRQRR (SEQ ID NO:97), RRQRRQRR (SEQ ID NO:98), RRQRRQRRQRR (SEQ ID NO:99).

31. The method of claim 25, 26, 27, 28, or 29 wherein the cargo is an apoptotic protein.

32. The method of claim 31 wherein the apoptotic protein is selected from the group consisting of p53, caspase-3, HSV thymidine kinase and an antimicrobial peptide.

33. The method of claim 32 wherein the antimicrobial peptide has an amino acid sequence selected from the group consisting of KLAKLAK (SEQ ID NO:22) and KLAKLAKKLAKLAK (SEQ ID NO:23).

34. The method of claim 30, wherein the anti-inflammatory agent is selected from the group consisting of NF- $\kappa$ B and CFTR peptides.

35. The method of claim 30, wherein the anti-oxidant is selected from the group consisting of superoxide dismutase (SOD) and manganese superoxide dismutase (MnSOD).

36. A method of internalization into a peptide-cargo complex into a cell, comprising administering to said cell an amount of said peptide-cargo complex and an agent which facilitates internalization.



37. The method of claim 53, wherein the agent is selected from the group consisting of dextran sulfate, heparan sulfate or protamine sulfate.

38. A method for internalizing a GST-fusion protein into a cell comprising administering to said cell a peptide-cargo complex and a GST fusion protein wherein the peptide has an amino acid sequence selected from the group consisting of MYRPPAANVDPW (SEQ ID NO:76), SSPPDLTTRTP (SEQ ID NO:77), ATTQSTPPAFHL (SEQ ID NO:78), SDLPHVSSYWRG (SEQ ID NO:79), TTTQFMEIRQSA (SEQ ID NO:80), GKTWKASDEDWT (SEQ ID NO:81), DPARILGRIFL (SEQ ID NO:82), YNLQPTTSARPT (SEQ ID NO:83), SLKTPTTSHLSQ (SEQ ID NO:84), TFDLRNNTHRNP (SEQ ID NO:85), SVSVGMKPSRP (SEQ ID NO:86), RRQRR (SEQ ID NO:97), RRQRRQRR (SEQ ID NO:98), RRQRRQRRQRR (SEQ ID NO:99).

39. The method of claim 38 wherein the cargo is glutathione.

40. A kit for internalizing a GST-fusion protein into a cell comprising a peptide-cargo complex wherein the peptide has an amino acid sequence selected from the group consisting of MYRPPAANVDPW (SEQ ID NO:76), SSPPDLTTRTP (SEQ ID NO:77), ATTQSTPPAFHL (SEQ ID NO:78), SDLPHVSSYWRG (SEQ ID NO:79), TTTQFMEIRQSA (SEQ ID NO:80), GKTWKASDEDWT (SEQ ID NO:81), DPARILGRIFL (SEQ ID NO:82), YNLQPTTSARPT (SEQ ID NO:83), SLKTPTTSHLSQ (SEQ ID NO:84), TFDLRNNTHRNP (SEQ ID NO:85), SVSVGMKPSRP (SEQ ID NO:86), RRQRR (SEQ ID NO:97), RRQRRQRR (SEQ ID NO:98), RRQRRQRRQRR (SEQ ID NO:99).

41. The kit according to claim 40 wherein the cargo is glutathione.

42. An immunogen comprising a peptide-cargo complex wherein said peptide has an amino acid sequence selected from the group consisting of MYRPPAANVDPW (SEQ ID NO:76), SSPPDLTTRTP (SEQ ID NO:77), ATTQSTPPAFHL (SEQ ID NO:78), SDLPHVSSYWRG (SEQ ID NO:79), TTTQFMEIRQSA (SEQ ID NO:80), GKTWKASDEDWT (SEQ ID NO:81), DPARILGRIFL (SEQ ID NO:82), YNLQPTTSARPT (SEQ ID NO:83), SLKTPTTSHLSQ (SEQ ID NO:84), TFDLRNNTHRNP (SEQ ID NO:85), SVSVGMKPSRP (SEQ ID NO:86), RRQRR (SEQ ID NO:97), RRQRRQRR (SEQ ID NO:98), RRQRRQRRQRR (SEQ ID NO:99).

43. The immunogen of claim 42 wherein the peptide has an amino acid sequence RRQRRTSKLMKR (SEQ ID NO:5).

44. The immunogen of claim 42 wherein the peptide has an amino acid sequence GVVGKLGQRRTKKQRRQKK (SEQ ID NO:73).

45. The immunogen of claim 42 wherein the cargo is selected from the group consisting of a polynucleotide, a polypeptide, a protein, a virus, a modified virus, a viral vector, and a plasmid.

46. The immunogen of claim 42 wherein the cargo is an antigen.

47. The immunogen of claim 42 wherein the cargo is an HIV protein selected from the group consisting of Gag, Pol, Env, Tat, Nef, Vpr, Vpv, Rev.

48. A method for eliciting an immune response in a subject comprising administering to a target cell of said subject an immunogen comprising a peptide-cargo complex

wherein said peptide has an amino acid sequence selected from the group consisting of MYRPPAANVDPW (SEQ ID NO:76), SSPPDLTTRTP (SEQ ID NO:77), ATTQSTPPAFHL (SEQ ID NO:78), SDLPHVSSYWRG (SEQ ID NO:79), TTTQFMEIRQSA (SEQ ID NO:80), GKTWKASDEDWT (SEQ ID NO:81), DPARILGRIFL (SEQ ID NO:82), YNLQPTTSARPT (SEQ ID NO:83), SLKTPTTSHLSQ (SEQ ID NO:84), TFDLRNNTHRNP (SEQ ID NO:85), SVSVGMKPSRP (SEQ ID NO:86), RRQRR (SEQ ID NO:97), RRQRRQRR (SEQ ID NO:98), RRQRRQRRQRR (SEQ ID NO:99).

49. The method of claim 48 wherein the target cell is a mucosal cell.

50. The method of claim 49 wherein the mucosal cell is a cervical mucosal cell.